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JOINT SPECTRUM CENTER
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SPECTRUM XXI Concept of Operations

JSC Project Engineer

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SECTION 1 - INTRODUCTION

1.1 BACKGROUND

In accordance with Program Budget Decision 082, the Joint Spectrum Center (JSC) was tasked to develop a standard, Department of Defense (DoD) -wide, spectrum management information system. Concurrently, the Joint Staff appointed the Commander of the JSC as chairman of the Joint Spectrum Management Working Group (JSM WG). The JSM WG provides a forum within the DoD spectrum management community for soliciting input for automation requirements and for determining the migration strategy for spectrum management automation.

Specifically, the JSM WG was tasked to "... address inclusion of spectrum management applications into the Global Command and Control System (GCCS)"¹ by

- articulating joint spectrum management requirements,
- nominating existing applications that meet those requirements, and
- identifying the need for further software development to satisfy those requirements.

At the first JSM WG meeting held 11 -12 June 1996, the DoD Unified and Specified Commands and Component Services representatives who are current users of spectrum management automation systems were asked to complete a requirements prioritization survey. The survey included over 500 spectrum management automation requirements identified from existing spectrum management systems, functional area policy and procedure documents, and potential improvement opportunities identified during the Management and Use of the Electromagnetic Spectrum (MUES) Business Process Re -Engineering study. Survey participants were also requested to identify any additional automation requirements necessary to support their mission and activities. All requirements identified through this survey comprise the total requirements of SPECTRUM XXI.²

These survey results were compiled and analyzed and then compared with defined procedures for management of spectrum in a joint environment.³ Only a subset of spectrum management requirements addressing Joint Restricted Frequency List (JRFL), Electronic Warfare (EW) deconfliction and interference

1 Global Command and Control Joint Spectrum Center Ad Hoc Working Group Establishment, Memorandum from the Vice Director for Command, Control, Communications, and Computer Systems, 15 April 1996.

2 Joint Spectrum Center, *Functional Requirements for SPECTRUM XXI* (Baseline) Annapolis, MD, January 1999

3 CJCSM 3220.01 - *Joint Operations in the Electromagnetic Battlespace*, 10 October 1997

reporting functionality is required by multiple CINC/Joint Task Force (JTF) staff sections (J2, J3, J6). This subset was forwarded to the GCC Review Board with a recommendation from the JSM WG that these functions be implemented as part of SPECTRUM XXI and be accessible to GCCS users via the web browser on the GCCS workstation.

The Joint Staff J-6 directed that the JSC develop SPECTRUM XXI as a Windows-NT-based application to address the spectrum management requirements of the CINCs, the Joint Task Force (JTF) commanders, the Services, and the sustaining base elements. To meet this direction, a subset of the total requirements defining an initial operating capability (IOC) was formulated based on the JSM WG survey results. The SPECTRUM XXI IOC will replace the Joint Spectrum Management System for Windows (JSMS_w) and the Frequency Resource Record System (FRRS) Distributed Computing Facilities (DCFs).

Subsequent software releases, to be defined and coordinated via the JSM WG, will address the remaining CINC and Service functionality identified through the survey as well as selected improvement opportunities identified as part of the MUES initiative.

1.2 DOCUMENT PURPOSE

This document provides a conceptual overview of SPECTRUM XXI in Joint Operations and Service and Sustaining Base spectrum management activities.

1.3 DOCUMENT CONTENTS

Section 2 presents a concept of operations (CONOPS) based on the policies, organizational structures and activities performed by spectrum management in support of Joint Operations and Sustaining Base Operations. A conceptual information system configuration is included to illustrate how networked automation will support spectrum management activities. Section 3 describes the SPECTRUM XXI architecture, including hardware and software requirements, application development, and system interfaces.

SECTION 2 - CONCEPT OF OPERATIONS

2.1 INTRODUCTION

Spectrum management within DoD involves the regulation and management of the electromagnetic spectrum, which is necessary to support operations using DoD spectrum-dependent equipment such as communications, weapons systems, sensors, and all other equipment that require use of the electromagnetic spectrum.^{4, 5, 6, 7, 8} Since each nation exercises sovereign domain over the electromagnetic spectrum within its borders, international treaties, status of forces agreements, and national regulations govern how, and by whom, segments of the spectrum are used.⁹ Use of the electromagnetic spectrum requires not only coordination with the host nations but also compliance with their radio regulations in order for DoD to operate its spectrum-dependent equipment in their geographical areas.

Spectrum management plays an essential role in supporting the warfighter in joint operations during peace and crisis situations.^{1, 3} The transition of spectrum management activities from sustaining base operations to joint operations needs to be seamless, rapid, and geographically independent. Automation supporting spectrum management must provide for a smooth transition between time of peace and crisis.

SPECTRUM XXI will provide a single information system that addresses all DoD spectrum management automation requirements. The SPECTRUM XXI IOC merges two joint spectrum management applications into a single DoD system and provides a target environment for future CINC and Service spectrum management system migration.

4 DoD Directive 4650.1- *Management and Use of the Radio Frequency Spectrum*, June 24, 1987.

5 MCEB Publication 5: *Frequency Resource Record System Organization, Mission and Functions Manual*, 30 August 1995.

6 Army Regulations 5-12 (AR5-12), *Army Management of the Electromagnetic Spectrum*, Department of the Army, July 1997.

7 Naval Telecommunications Procedures (NTP-6D) Supplement 1-T: *Spectrum Management Manual*, 1994.

8 Air Force Instruction (AFI) 33-118: *Radio frequency Spectrum Management*, Air Force Frequency Management Agency, 1 October 1995.

9 ACP-190 U.S. Supp-2, "Coordination and Registration of Frequencies Used by Military Forces on Foreign Soil" (Confidential), June 1990.

2.2 CURRENT SPECTRUM MANAGEMENT SYSTEM CONFIGURATION

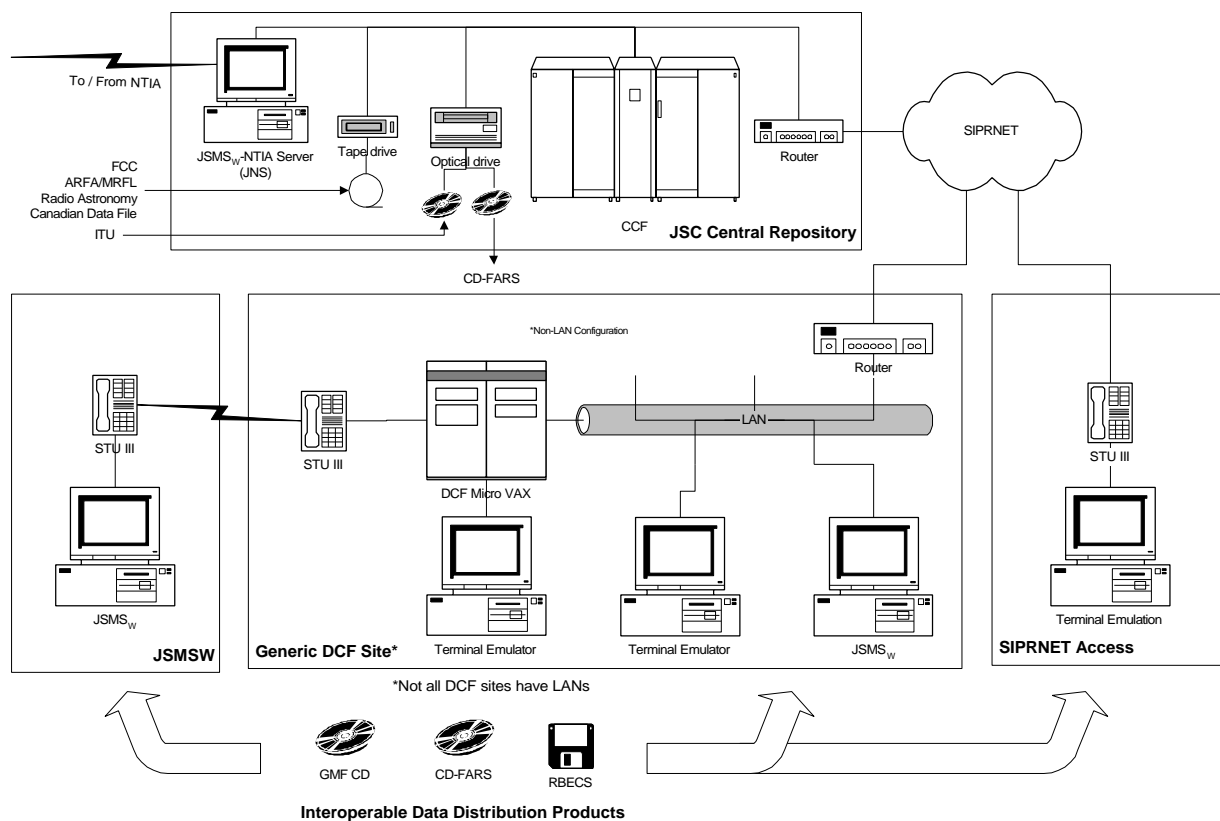


Figure 2-1 Current Spectrum Management System Configuration

Figure 2-1 illustrates the current spectrum management system configuration involving the JSC Central Repository Central Computer Facility (CCF), DCF Sites, and JSMS_w Sites.

2.2.1 JSC Central Repository

The JSC Central Repository provides DoD spectrum management with a central database that includes the FRRS, the Background Environment Information (BEI) file, Spectrum Certification (SC) database, and the Tactical Systems (TACSYS) database. The JSC Central Repository also serves the JSC internal electromagnetic compatibility/vulnerability (EMC/V) and electromagnetic environmental effects (E³) analyst community. The JSC Central Repository provides the mechanism to transfer data to and from the National Telecommunications and Information Administration (NTIA) as part of the permanent frequency assignment process for DoD in the United States.

2.2.2 DCF Sites

The DCF sites provide a number of functions which include: proposal status tracking and frequency assignment data distribution of assignment updates, remote access

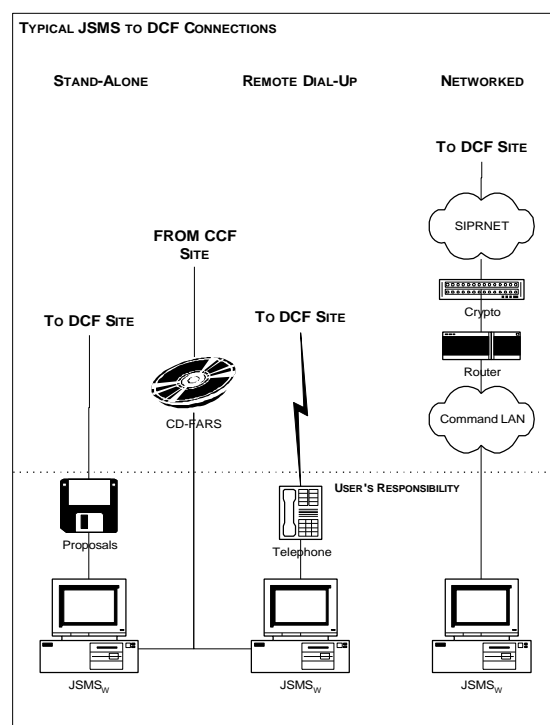
FRRS retrievals, proposal processing, retrieval, editing and validation of frequency proposals, and management reports. The DCF sites support multiple spectrum management elements involved with joint and sustaining base operations. DCF sites are permanently connected to the JSC Central Repository CCF via the Secure Internet Protocol Network (SIPRNET) Wide Area Network (WAN).

2.2.3 JSMS_w Sites

JSMS_w sites support spectrum management activities during both tactical and sustaining base operations. During tactical operations, JSMS_w supports establishing and maintaining the frequency use database and identifies candidate frequencies; supports development of the JRFL; supports engineering of compatible frequency use; generates and maintains allotment plans; helps coordinate new systems in theater, and helps resolve interference. At the sustaining base, JSMS_w supports acquisition of permanent frequency assignments; manages temporary frequency assignments; helps resolve interference and supports the DoD spectrum dependent equipment acquisition process through spectrum certification.

JSMS_w sites may operate stand-alone, through remote dial-up, or may have a permanent connection via SIPRNET to a DCF site. JSMS_w interfaces are explained in greater detail in Section 3.

Figure 2-2 JSMS_w Interface



2.3 SPECTRUM XXI SYSTEM

SPECTRUM XXI is a software application that requires hardware platforms, commercial software and WAN access to accomplish its full capability. SPECTRUM XXI IOC will replace the JSMS_w and the DCF portions of the current, spectrum management systems configuration. The SPECTRUM XXI system hardware configuration is comprised of three major components: the Central Server (CS), Regional Server (RS), and client platforms. Figure 2-3

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depicts the relationship among these components and their relationship to the SIPRNET and the JSC CCF.

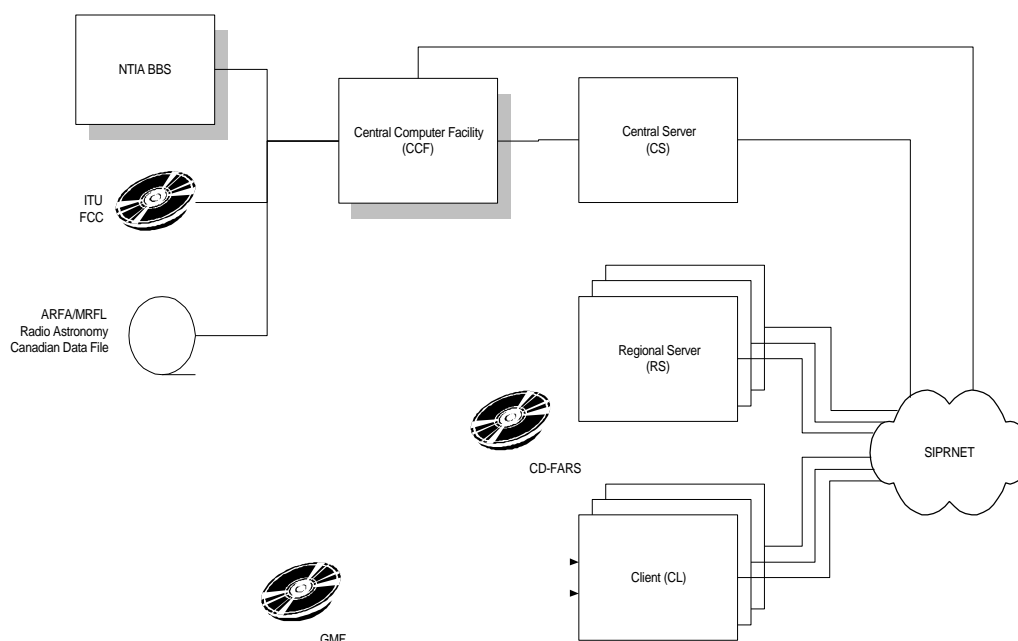


Figure 2-3 SPECTRUM XXI System Configuration

SPECTRUM XXI operation is based on the use of a WAN to transfer files. While each client will have a complete stand-alone database and set of applications, the capability to efficiently transfer files between non-located major components and to maintain current data will depend on the WAN. Two types of WAN connections are envisioned: a direct SIPRNET connection and a secure telephone unit (STU). SPECTRUM XXI Exchanging Clients can access a regional server via SIPRNET or dial-up via STU-III directly to a regional server site or a secure terminal server connected to the SIPRNET.

SPECTRUM XXI is designed to replicate the actual spectrum management business (Coordination) process. To accomplish this goal and provide cradle-to-grave status tracking of proposals and assignments, changes to the process that electronically coordinates frequency proposals had to be implemented.

Proposals are electronically exchanged between SPECTRUM XXI client terminals by use of a Regional Server (RS). Each SPECTRUM XXI user who creates, edits, or coordinates frequency proposals will have a Job Account. A Job Account is used to determine who has edit authority for a particular proposal and as an address for coordination purposes. A Job Account should identify a spectrum management organization and a particular function within that organization, easily recognizable to other spectrum managers (i.e., AFFMA M225-400, EUCOM M30-88, but not an individual's name). Service Components

and CINC Frequency Management Offices will have to define a standard for what Job Accounts' will look like within their own offices.

Proposals will have a defined set of criteria for status, as opposed to being the user-defined in the Distributed Computer Facility (DCF). These criteria are divided into three types; Automated Statuses, Operator Initiated Dispositions, and Data Exchange Actions (Electronic Coordination). Listed below are the new status options and their attributes.

- **Automated Statuses** (in response to operator actions)

<u>Status Code</u>	<u>Action/Event</u>
ORIGINATED BY	New proposal created in proposal editor
IMPORTED BY	New proposal imported via SFAF import
IN-PROCESS AT	Proposal opened in editor (first time only)
MODIFIED BY	Proposal modified and saved in editor (last time only)
RECEIVED BY	Proposal received by current edit authority
COMPLIANCE	Proposal compliance checked

- **Operator Initiated Dispositions** (operator selections made from proposal editor)

<u>Status Code</u>	<u>Action/Event</u>
APPROVED BY	Proposal approved for further processing
REJECTED BY	Proposal rejected by the current Job Account
ASSIGNED BY	Proposal assigned by the current Job Account
DELETED BY	Proposal or assignment deleted by the current Job Account

- **Data Exchange Actions** (operator initiated from Electronic Coordination)

<u>Status Code</u>	<u>Action/Event</u>
FORWARDED TO	Proposal forwarded with edit authority
SUBMITTED TO	Permanent Proposal submitted to NTIA
REGISTERED WITH	Permanent Proposal to Assignment, registered with FRRS
NOTIFIED BY	Temp assignment sent to server for community visibility
INFO TO	Courtesy copy of proposal sent

Each SPECTRUM XXI terminal has a Client Profile that identifies active job accounts, connectivity preferences, default electronic coordination data, and the Area of Interest (AOI) for the terminal. An AOI for a SPECTRUM XXI terminal is defined by a point and radius, a query on an individual SFAF item(s), or a combination of the two.

2.3.1 Central Server Site

A CS will be added to the JSC CCF to provide DoD-wide access to data common to all spectrum management users. This server will contain permanent frequency assignments from data sources such as the FRRS, the Government Master File (GMF) as well as temporary assignments supporting the JTF and sustaining base operations.

When a transactional updating method is available for the Federal Communications Commission (FCC) and the International Telecommunications Union (ITU) frequency assignment databases, these records sources will be added to the CS.

Databases on equipment characteristics, spectrum supportability and certification status, and host nation regulatory compliance (e.g., ITU Table of Allocations footnotes) for both frequency assignments and equipment certification will be added to the CS once a designated process has been defined by the members of the JSM WG.

Frequency allotment plans, JRFL, Communications-Electronics Operating Instructions (CEOI), and deconfliction assessments will be added to the CS upon the determination of policy and doctrine concerning the generation and dissemination of these data types.

Database replication will be used to update the CS and RS databases. These databases are kept identical within a one-hour differential, due to network traffic loads and data exchange transfer rates. All data resident on any server will be available from any other RS or the CS. Large data files (e.g., background assignment data) can also be distributed to RS sites via CD-ROM products created by the CS. The CS will interface with the JSC FRRS CCF using a direct connection. The CCF will continue to serve as the primary storage device for DoD frequency assignment information and for use in coordinating Continental United States (CONUS)-based DoD frequency proposals with the National spectrum management community.

Inserting a CS between the CCF and the SPECTRUM XXI users will provide a consistent user interface for data queries and will allow database-to-database transfers using features inherent to the commercial off-the-shelf (COTS) database management system (DBMS) residing on the CS, each RS, and on the SPECTRUM XXI client.

2.3.2 Regional Server Sites

SPECTRUM XXI will replace the functionality and hardware associated with the FRRS DCFs (e.g., MicroVAX and associated DEC terminals and printers). An

RS site will replace the DCF data server functionality, while a client at the RS site will replace all other DCF functionality.

Figure 2-4 illustrates a notional Regional Server at a major spectrum management office, and depicts an Regional Server as it relates to a local area network (LAN) and SPECTRUM XXI clients.

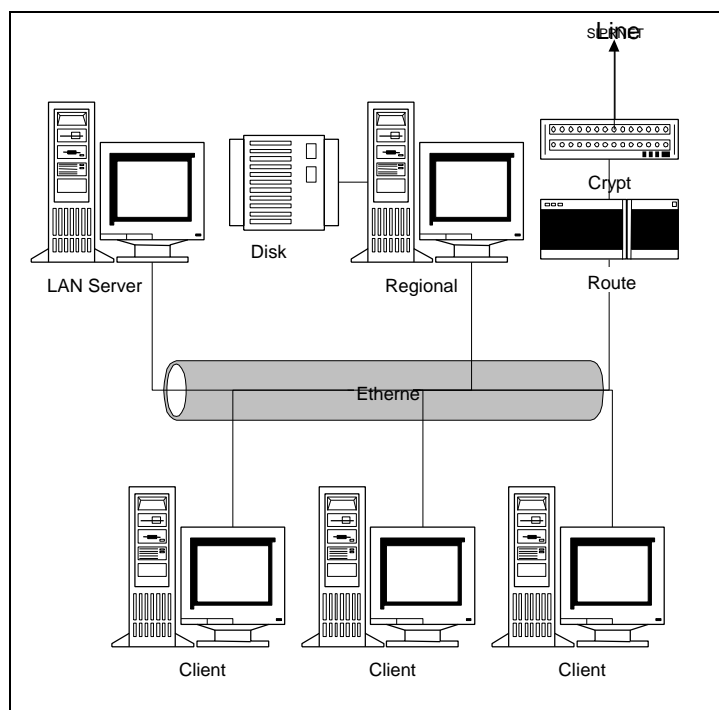
Each RS site will store and provide access to data, common to all SPECTRUM XXI clients, and to the Army's Integrated System Control (ISYSCON) terminals within a geographic region. This data will include the frequency proposal and frequency proposal status, FRRS and GMF frequency assignments.

Each RS will be configured to support a minimum of eight (8) simultaneous clients. The RS will receive data uploaded from SPECTRUM XXI clients, as well as respond to data queries from client sites. The RS will download database updates to client sites based on Job Accounts and the AOI that exist in the SPECTRUM XXI client's profile.

Figure 2-4 - Regional Server Site

Regional Servers will maintain concurrent duplicate databases via a redundant set of disk drives. In the event of an RS hardware disk failure, the damaged disk can be substituted with one of the duplicated disks until the damaged disk can be repaired and replaced.

The JSC will configure and install three RS sites; a Europe-based site, a Pacific-based site, and a CONUS-based site. The selection of the European and Pacific RS sites will be based on the reuse of the existing theater hubs. RS sites will be maintained jointly by the JSC and the hosting organization. A system manager will be assigned to support each of the RS sites. System administration functions assigned to the JSC will be performed over SIPRNET, where possible, and via site visits when necessary.



2.3.3 Client Sites

Client sites will be grouped into three basic categories: Client sites supported by a LAN, Direct SIPRNET access, and Remote Dial-up. These Client site configurations are shown in Figure 2-5. Client sites are designed to be operated in one of two modes: Exchanging Client (i.e., exchanging data with RS and client sites) and an Independent Client (i.e., stand-alone with the client site hosting all needed data).

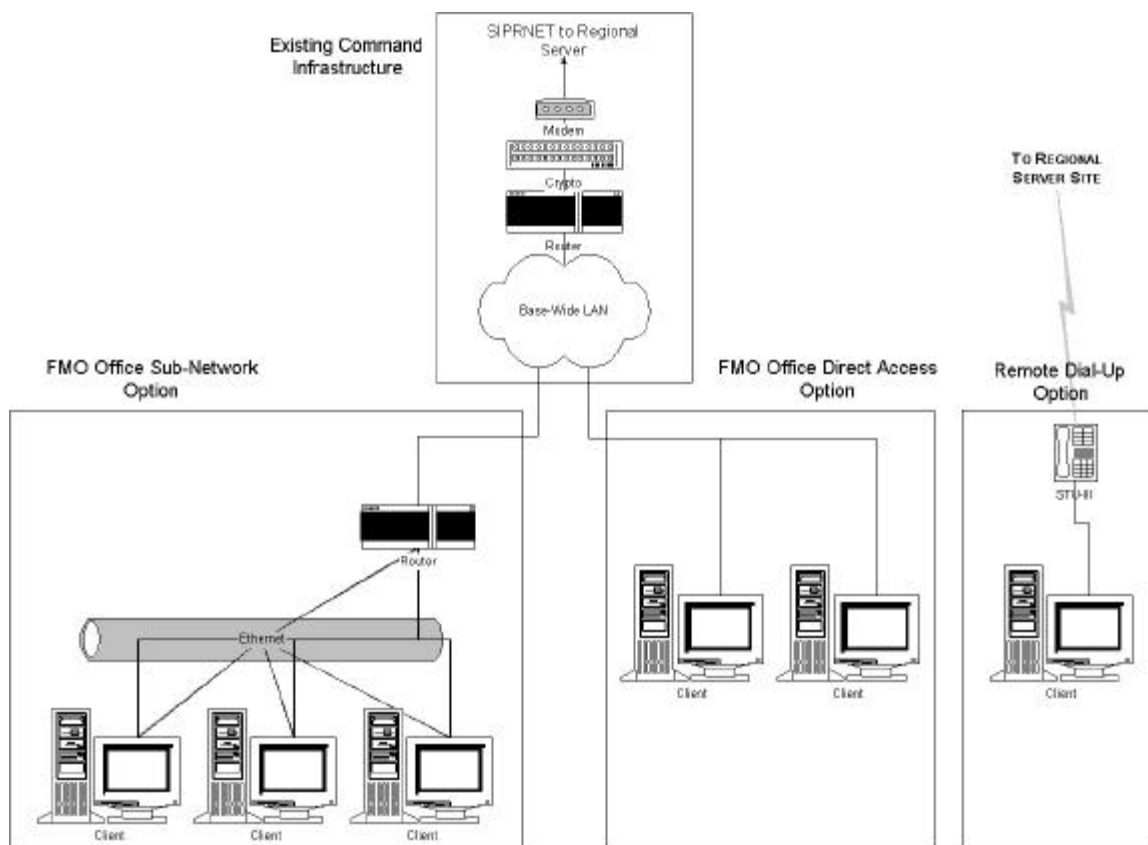


Figure 2-5 Client Site Configurations

Spectrum management users will be able to exchange frequency record data (automatically or on demand) with other SPECTRUM XXI client platforms via SIPRNET or a secure telephone unit (e.g., STU-III). This data exchange is performed using the regional or central server as the data exchange server.

Each client platform will have a local database that supports the various spectrum management activities of that site, such as a CINC site, a Service site, a JTF/Component site, an Area Frequency Coordinator (AFC) site, or a Base, Post, Camp, and Station (BPCS) site. These platforms can be located anywhere. They will have the capability to access spectrum management data from any of the three Regional Servers, or in the event that an Regional Server site is not accessible, with the Central Server to acquire updates of FRRS and GMF

transactions and to coordinate frequency proposals between JTF/Component sites. Client platforms and the Regional Servers will update each other's frequency record databases using the SPECTRUM XXI data exchange capability and will receive updates on frequency transactions occurring in their area of interest.

SPECTRUM XXI client sites will be able to automatically or on demand, exchange data with a RS site via SIPRNET or STU-III. A client site will receive formal data (data distributed or submitted as part of the spectrum-management-coordination business process) from an RS site or will receive informal data (file or information attached to an Email) from another client site.

Data replication will not be automatic at a client site. However, data backup features (e.g., CD-ROM reinstallation of the client application software) and reselection of frequency assignment data from the RS site will be provided.

2.4 RELATIONSHIP TO GCCS

SPECTRUM XXI will provide a WEB browser based capability that will allow GCCS users access to the current Joint Restricted Frequency List Data (JRFL), Interference Report database, and EW Deconfliction analysis results.

GCCS and SPECTRUM XXI both utilize the SIPRNET for secure wide area networking. User will be able to access spectrum management information as it relates to functions performed by multiple CINC/JTF staff sections from a SPECTRUM XXI RS or a client site via the web browser resident on the GCCS workstation. GCCS users will access a home page associated with an exercise, contingency or operation; whereby, the data necessary for JRFL coordination, EW deconfliction and frequency interference reporting can be entered or retrieved by the J2, J3, or J6, as appropriate.

2.5 TYPICAL SYSTEM

2.5.1 Joint Operations

To accomplish the seamless and rapid transition of spectrum management activities between peacetime and crisis situations, there must be a commonality of spectrum management information system data, process, infrastructure, and interface. Support of crisis operations does not change the type of spectrum management activities performed, but rather compresses the time within which they must be accomplished.

Figure 2-6, summarizes the major transactions between the CINC/JTF spectrum management components.

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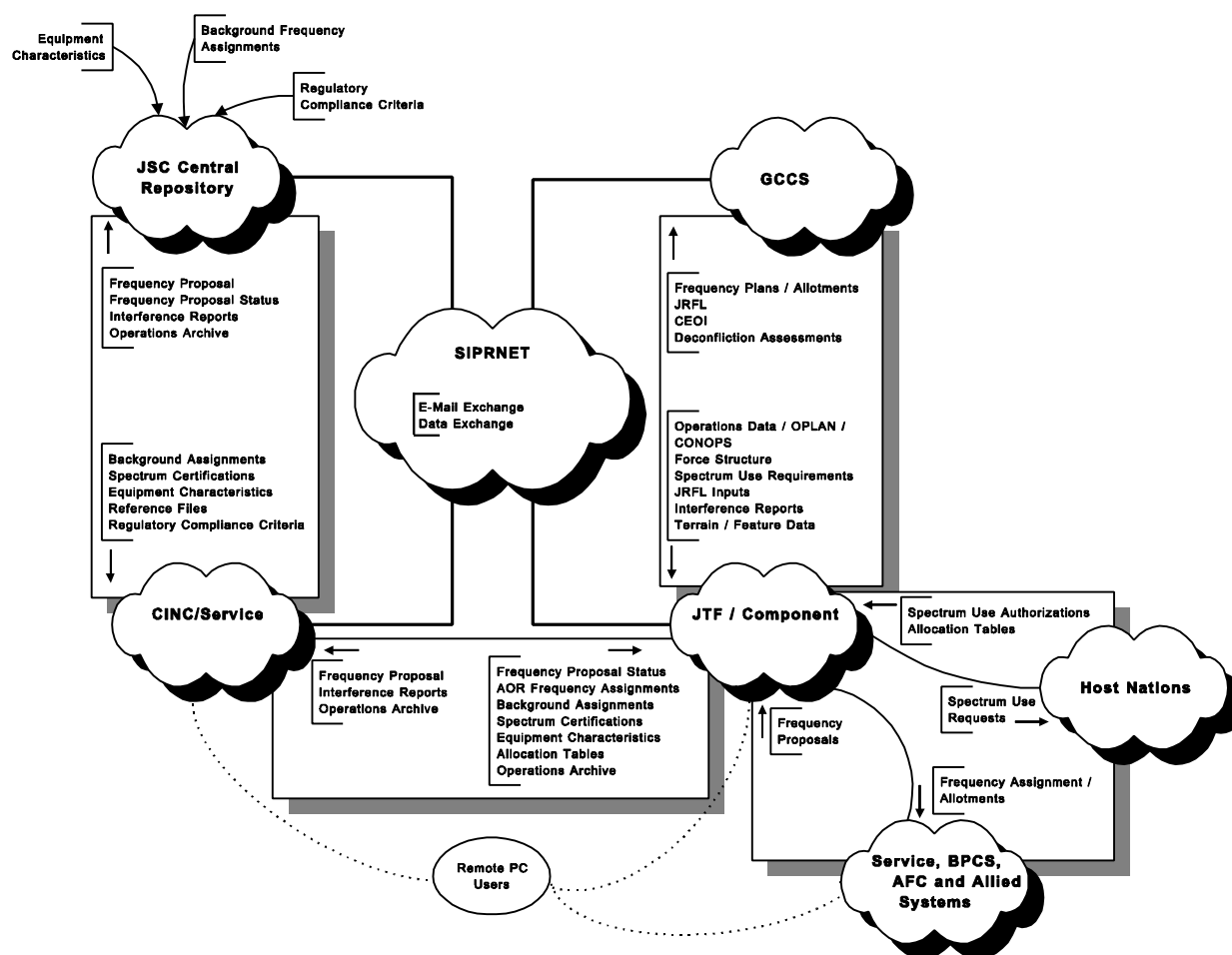


Figure 2-6 Joint Operations Spectrum Management Interactions

During the crisis planning cycle, the CINC's Joint Frequency Management Office (JFMO) typically performs the initial spectrum management planning. Extracts of emerging Courses Of Action (COAs) and Operational Plans (OPLANS) will be acquired from the GCCS and assessments of spectrum supportability and the required spectrum support will be formulated. The JTF/Component sites will download all necessary data from the CINC/Service sites, the applicable RS site, and the GCCS site to support spectrum management activities.

Direct connectivity with the JTF and its components will be established, and the collection of JTF spectrum-use requirements will begin using an automatic data exchange whenever possible. Liaison with the appropriate host nations, coalition, and allied forces is initially established by the CINC and then transitioned to the JTF.

A database of spectrum requirements, resources, assignments, and allotments will be tailored to the specific joint operation and maintained through transaction updates between the joint operation designated CINC/Service and

JTF/Component sites. Coordination with the emerging JTF and the transfer of spectrum management responsibility from the CINC JFMO to the JTF FMO will be accomplished by transfer of authority and by the transfer of spectrum management data to the JTF/Components Spectrum Management sites.

Frequency assignment databases within the JTF area of responsibility (AOR) will be networked together and updated automatically whenever a frequency assignment is made. This process of using a distributed database provides the frequency assignment authority with a near-real time electromagnetic background of the region. This allows for maximum frequency reuse and optimizes the use of the limited spectrum resource while providing the user protection from electromagnetic fratricide.

The JTF FMO is a member of the Joint Electronic Warfare Cell (JEWEC) and consolidates data inputs from the J2, J3, J5, J6, and JTF components to create the JRFL. The JRFL is a listing of frequencies that are so critical that when jammed by friendly forces they would disrupt friendly operations and cause possible danger to life situations. The J6 input provides a listing of critical Command and Control (C²) radio nets requiring protection from friendly jamming. The J2 input provides a listing of enemy frequencies being monitored by friendly forces for intelligence purposes that need to be guarded from friendly jamming. The J5 input is a consolidation of civil frequencies that if jammed will cause life-threatening situations. The J3, which is the final approval authority and arbitrator of operational conflicts between the different staff sections, finalizes the JRFL.

2.5.2 Sustaining Base Operations

Sustaining base spectrum management activities will support garrisoned forces, the DoD spectrum-dependent equipment acquisition process, and the spectrum-dependent infrastructure requirements of the CINCs and Services. Data, acquired and maintained during peacetime, will form the basis for the data required in order to support joint operations. Figure 2-7 summarizes the major transactions between the sustaining base spectrum management components.

SPECTRUM XXI Concept of Operations

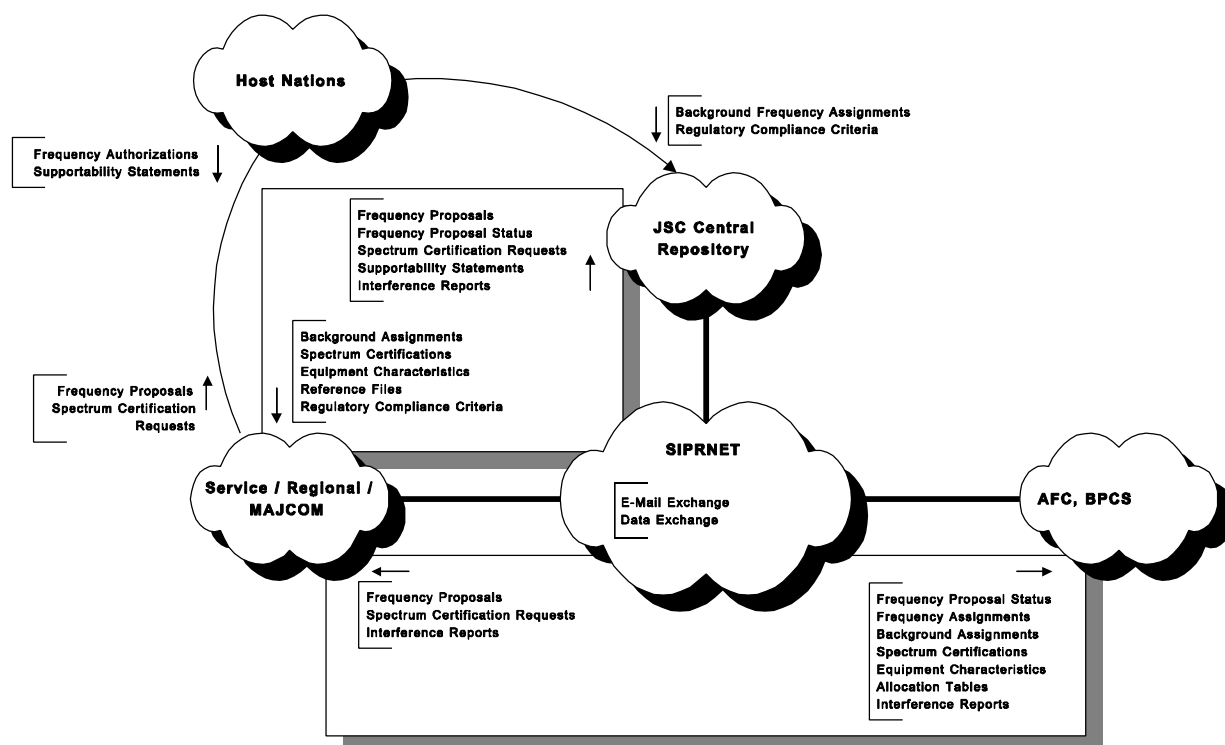


Figure 2-7 Sustaining Base Spectrum Management Interactions

Frequency proposals prepared and validated at the BPCS site will be forwarded to the regional, command, and CINC/Service sites. Each proposal will be tracked based on its coordination and authorization status. The appropriate host nation liaison point of contact will format (e.g., GMF, NATO ADEF, etc.), prepare, and forward the proposal to the host nation for authorization. Host nation authorization, along with any operational restrictions, will be recorded and the assignment will be forwarded to the requester.

Requests for temporary frequency assignments will be initiated at the BPCS site and satisfied by local frequency resource assets if available. If not, the request will be forwarded to the regional/major command site. Upon assignment, the user will be notified and made aware of any operational restrictions on the temporary frequency assignment (e.g., daylight hours only).

Spectrum certification requests will be prepared and validated at the project office (BPCS) site and forwarded to the regional, command, and Service sites. Each spectrum certification request will be tracked based on its coordination and supportability status. The appropriate host nation liaison (either the Service or CINC) will format, prepare and forward the releasable spectrum certification requests to the appropriate host nation for consideration. Host nation supportability statements, along with any operational restrictions, will be recorded, and the certification will be forwarded to the requester.

Interference reports will be prepared at the spectrum management site receiving notification of the interference. A database analysis, site survey, and coordination with other nearby spectrum management sites may be conducted to identify the cause of the interference. Unresolved interference cases will be forwarded to the next spectrum management level for resolution. The interference incidents and resolution will be recorded and distributed for future reference.

2.6 SPECTRUM XXI UTILIZATION

For any particular JTF operation, SPECTRUM XXI will be employed to support spectrum management throughout all JTF phases. Each system employed will have its own configuration. Recommended users of SPECTRUM XXI include the following:

- CINC
- Service and Special Operations components
- Joint Communications Control Center (JCCC)
- Joint System Control (SYSCON)
- JTF component's SYSCONs
- JTF Frequency Management Office
- Joint Special Operations Task Force (JSOTF) JCCC
- Selected supporting CINCs.

CINCs that establish JTFs must be capable of supporting two simultaneously deployed JTF headquarters with a stand-alone SPECTRUM XXI capability. Each of these commands will require three configurations; two available for deployment to JTF headquarters and the third to reside permanently at the CINC. It is recommended that JTF component commands have the frequency management office of the major force elements use SPECTRUM XXI as well. Services are encouraged to employ SPECTRUM XXI as the baseline spectrum management system at all echelons, including sustaining base and BPCS organizations. This will ensure the concept of C4I for the Warrior by providing common user interfaces for all spectrum management applications and will maintain the proficiency of spectrum managers regardless of current duty assignment. Thus, any Service or Joint Communications Support Element (JCSE) unit assigned to support a JCCC will be familiar with the SPECTRUM XXI interface. The parent Service will determine the exact number of units/agencies that will require SPECTRUM XXI.

2.7 SPECTRUM XXI FIELDING

The initial fielding and training of SPECTRUM XXI are planned to begin in mid October 1999. CINCs and Services will be required to procure all required hardware and software prior to fielding at their respective locations. Hardware and COTS software requirements are addressed in Section 3. SPECTRUM XXI fielding is fully defined in the SPECTRUM XXI Transition Plan dated February 1999.

2.7.1 Training

SPECTRUM XXI training will address a broad audience of users ranging from a school-trained, field-experienced Spectrum Manager to a part-time, non-trained, non-experienced, Post/Camp/Station/Base frequency manager. To address the needs of the spectrum management community, a modular training package is planned. This package will enable the instructor to tailor the course to the specific needs of the attendees. JSC SPECTRUM XXI training will be based on a combination of lectures and hands-on practical exercises with maximum emphasis placed on the practical exercise-based instruction. Off-site training conducted by JSC personnel will also be available upon request. Hardware maintenance training will not be included.

SPECTRUM XXI training materials and curriculum will be coordinated with the DoD and Service frequency management schools. SPECTRUM XXI training will be available from IRFMS and the US Army Battlefield Spectrum Management Course (BSMC) upon completion of SPECTRUM XXI transition. IRFMS and BSMC will become the primary trainers for new SPECTRUM XXI users. Hardware maintenance training will not be included.

The SPECTRUM XXI Transition Plan, dated February 1999, provides details on the training curriculum and provides guidance for who should attend training and how much training will be required for each type of user.

2.7.2 Post Deployment Software Support

Subsequent to SPECTRUM XXI IOC Product Acceptance Test and Evaluation (PATE), software releases addressing Post-IOC automation requirements ² will be developed, tested, and fielded. The JSM Configuration Control Board (CCB) will identify and approve software corrections and enhancements and will prioritize requirements for each Post-IOC software release. For each release, enhancements and/or corrections to SPECTRUM XXI software, necessary documentation changes, and replication and distribution of the updated software and documentation will be provided to the previously fielded units/agencies.

Post Deployment Software Support (PDSS) will include the following services:

On-Call Assistance - The JSC will maintain a 24-hour a day, seven-day-a-week hotline to resolve user software problems. The service will include on-call software expertise for immediate trouble-shooting, software diagnostic capabilities, testing facilities, and database management.

On-Site Support - At the request of a unit/agency and with authorization from the JSC, software and hardware support will be provided at the unit/agency location as required.

2.8 TRANSITION TO SPECTRUM XXI

Transition from the current, spectrum management system configuration to SPECTRUM XXI will require concurrent operations until agencies are confident enough to complete the migration. A Transition Plan for the FRRS DCFs and JSMS_w will be prepared to ensure a smooth transition from these legacy systems to SPECTRUM XXI. This plan will contain a detailed, time-phased cutover plan. It will also document the location of the RS sites, the system management responsibilities for the RS sites, and the schedule for installing the RS sites. The plan will detail the de-installation process and schedule for the DCFs. A draft version of the Transition Plan was provided to the spectrum management community in February 1999 for comment. JSM WG meeting will be held in May 1999 to finalize the CONOPS, Transition Plan, and Functional Requirements.

SECTION 3 - SPECTRUM XXI ARCHITECTURE

3.1 SYSTEM OVERVIEW

SPECTRUM XXI will be a Windows-NT-based application that will make maximum use of the Microsoft Windows presentation techniques. It will provide basic database services and spectrum management functionality to the user. SPECTRUM XXI systems will be interconnected, via Regional Server, with other SPECTRUM XXI systems to allow for the maximum amount of electronic data transfer. The SPECTRUM XXI software system will replace the existing DoD spectrum management systems of JSMS_w and FRRS DCF by combining the functionality of those two systems into a single suite of software.

3.2 HARDWARE AND SOFTWARE REQUIREMENTS

The SPECTRUM XXI hardware requirements are based on the type of site, as discussed in the Section 2. Table 3-1 identifies the required platform requirements for each site type. Requirements are provided for the RS site configuration and the client site configurations.

The hardware characteristics provided in Table 3-1 reflect those that are required by SPECTRUM XXI. Higher performance and/or capacity items can be substituted. However, CINC/Service procurement agencies should ensure that Windows NT supports all procured hardware and COTS software. A Windows hardware compatibility list (HCL) and software compatibility list (SCL) provide vendor- and model number-level descriptions of supported items; these lists can be found on the World Wide Web: www.microsoft.com

Depending on the type of SIPRNET connectivity option selected, the client site will have to obtain either a STU-III or SIPRNET direct connection equipment from the Defense Information Systems Agency (DISA).

Table 3-1 SPECTRUM XXI Hardware Configurations¹

	Regional Server	Client Configuration
CPU	Dual Pentium II	Pentium II
RAM	128 MB	64 MB
Disk Drives	12 - 4 GB	See Table 3-2 ¹
Cache Memory (L2)	TBD	512 k
Controller	SCSI (Adaptec 2940)	IDE
Monitor	21" 1280x1024 pixels	17" 1280x1024 pixels ²
Graphics	Yes	Yes
Accelerator	2 MB	2 MB
Video Memory		

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	Regional Server	Client Configuration
CD-ROM	12x or faster	12x or faster
PCMCIA Type II Card Slots ³	2 each	2 each
Printer	600x600 dpi NT supported	600x600 dpi NT supported
Tape Backup	4 mm, SCSI	4 mm
Floppy Disk	3.5"	3.5"
Mouse, Keyboard	Yes	Yes
UPS	Yes	650 VA ⁴
Operating System	NT 4.0 (Server)	NT 4.0 (Workstation)
<p>1 Hard disk drives should be removable.</p> <p>2 SPECTRUM XXI may also be hosted on a Laptop computer supporting a 1024x768-pixel display.</p> <p>3 PCMCIA Type II card slots are for use with Fortezza cards.</p> <p>4 American Power Conversion (APC) model Back-ups Pro 650 VA or equivalent.</p>		

SPECTRUM XXI takes into account the background assignments within the FMO's area of responsibility (AOR) as well as the terrain elevation and feature data for the region. This makes the disk drive requirements dependent on the size of the FMO's AOR.

Table 3-2 provides general guidance on the required size of the Client platform hard disk relative the anticipated number of frequency records stored on the platform.

A small (2 GB Disk Drive) Client configuration is intended for the base or installation frequency manager and the frequency action officer assigned to a large FMO. This smaller size drive will support a base or installation frequency manager having an AOR with a radius of 200 miles or less and requiring storage of approximately 200,000 frequency records. If a base or installation frequency manager is responsible for a larger AOR, then a larger disk drive, 3.2 GB, 6.4 GB, or larger, should be procured based on the information in Table 3-2.

Table 3-2 Recommended Disk Size Based on the Number of Frequency Records

# Frequency Records	Storage Space Required (GB)	Recommended Minimum Disk Size (GB)
10,000	0.04	2.1*
20,000	0.07	2.1*
30,000	0.11	2.1*
50,000	0.18	2.1*
100,000	0.36	2.1*
200,000	0.73	2.1
300,000	1.09	3.2*
500,000	1.82	6.4**
1,000,000	3.63	7.5**
2,000,000	7.27	13.5**
3,000,000	10.90	16.8**
*For smaller disks SPECTRUM XXI should not occupy more than half the disk.		
**Windows NT restricts the boot disk partition to 4 GB. Configure the other disk partition as a single large drive.		

In the case of a frequency action officer assigned to a large FMO, a similar criterion may be applied. Activities in larger FMOs tend to partition their duties either by frequency bands or by geographical areas of responsibilities.

A small disk Client configuration of 2.1 to 3.2 GB will support about 200,000 background assignments in addition to up to 10,000 permanent proposals and assignments. If this criterion appears constraining, then a larger disk drive, 6.4 to 7.5 GB, should be procured.

The recommended COTS software to support SPECTRUM XXI operations is shown in Table 3-3. The Office Automation and GCCS options are not required by SPECTRUM XXI, but are typical software requirements, depending on the mission of the client site.

3.3 SPECTRUM XXI SOFTWARE DEVELOPMENT

The JSC will develop software for the SPECTRUM XXI client using Microsoft applications Visual FoxPro and Visual Basic. The Regional and Central Servers will be developed using Visual Basic and Oracle. The graphical user interface (GUI) will be developed using the MS Windows presentation techniques. The database will be implemented using the Structured Query Language (SQL) standard.

In the development of SPECTRUM XXI, the functionality of all existing spectrum management systems will be consolidated using modern hardware and software development techniques. Consolidating the spectrum management functions into one system also provides an opportunity to consolidate the software behind

those functions into a single reusable library. This software library can then be reused throughout the National and DoD spectrum management community, providing a single, common baseline for spectrum planning and management-related tasks and reducing the problems of multiple versions of the same software.

Table 3-3 SPECTRUM XXI COTS Software

	Regional Server	Client
Database	Oracle* 8 Server for NT	DBMS included with SPECTRUM XXI software
E-mail	Not Applicable	UFS ¹
Web Browser	Not Applicable	UFS (Netscape ²)
Telecommunications	TBD	UFS
Tape Backup	TBD	UFS ³
Office Automation	Not Applicable	UFS (MS Office ²)
Virus Protection	TBD	UFS
GCCS	Not Applicable	UFS ⁴
UFS - User Furnished Software		
The number of licenses purchased establishes the maximum number of simultaneous users.		
¹ Defense Messaging System (DMS) compliant, such as MS Exchange		
² Defense Information Infrastructure (DII) Compliant NT software		
³ NT Compliant 4mm tape backup software		
⁴ GCCS NT Segments determined by user requirements and acquired from DISA		

To facilitate configuration management and interoperability, the JSC will generate, maintain, and update a single SPECTRUM XXI baseline. This software baseline will be provided to all SPECTRUM XXI users. Each Service will be responsible for developing any unique modules and providing these to the JSC for integration into the software baseline. CINCs or Services (for BPCS users) will determine which Service-unique modules, if any, should be available as part of SPECTRUM XXI implementations employed in their area of operation. To maximize compatibility, all Service-unique software applications installed on the same platform as SPECTRUM XXI should adhere to the same standards established for SPECTRUM XXI. The JSC will further specify any technical criteria that must be met for Services to add unique functions to SPECTRUM

XXI.

The JSC will generate, maintain, and update one client site and one RS site software baseline. Each Service will be responsible for developing or installing any unique modules to provide to the JSC for integration into the software baseline. For example, Navy-unique functional modules that were extracted from ASPECTS will be integrated with SPECTRUM XXI for the Navy. Thus, the Navy-unique functionality and databases will be available to Navy users, but will not be provided to joint and other Service elements. Prior to having the Services add unique modules and databases, the JSC and JSM WG, in conjunction with the CINCs, will verify that (1) the existing joint functionality in SPECTRUM XXI does not already provide the Service-required capability, and (2) the capability is not a joint requirement. If the capability is a joint spectrum management requirement, it will be added to the SPECTRUM XXI software baseline and will not be added as a Service-unique module.

3.4 INTEGRATED DATABASE

An integrated database that uses common data elements and dictionaries will support the joint functional modules. The DISA/Joint Interoperability and Engineering Organization (JIEO) Center for Standards is working to develop common data dictionaries and data elements for use in joint databases to enhance interoperability of systems. NTIA is conducting similar efforts associated with all federal government spectrum users. The JSC will ensure that SPECTRUM XXI database uses the joint standards or submits new requirements to the joint standards committees. In addition, the JSC will monitor, and where appropriate, synchronize the SPECTRUM XXI database with emerging federal and allied (e.g., NATO) data standards.

3.5 INTERFACES

SPECTRUM XXI will support data exchanges with other SPECTRUM XXI components and with a number of information systems including tactical and non-tactical spectrum management and communications planning systems. SPECTRUM XXI will exchange Standard Frequency Action Format (SFAF) vertical ASCII formatted data with legacy spectrum management systems and other systems that support the current SFAF data exchange format (e.g., Mobile Subscriber Equipment - Network Planning Terminal (MSE-NPT) and ASPECTS). SPECTRUM XXI will also exchange Revised Battlefield Electronic CEOI System (RBECS)-formatted data.

Table 3-4 provides an overview of these high-level interfaces with examples of the types of data that can be exchanged. Individual interface control documents will be developed for each interface.

Table 3-4 SPECTRUM XXI Interfaces

Interface	Direction	Method	Format	Type of Data (examples)
CL-to-RS	2 way	Electronic	Oracle and ASCII SFAF	Submitted proposals, database updates, allotment plans, temporary frequency assignments
CL-to-CL	2 way	Electronic	e-mail	Coordination information
CL-to-CS	2 way	Electronic	Oracle and ASCII SFAF	Background environment data
CS-to-RS	2 way	Electronic	Oracle and ASCII SFAF	Proposal status information, approved proposals and assignments, background environment information
GCCS	2-way	Electronic	TBD	JRFL, frequencies deconflicted with EW plans, interference reports, OPLANS, TPFDD, spectrum use requirements
RBECS	2 way	Floppy disk or file transfer	RBECS file	allotment plans, CEOIs
ISYSCON	2 way	Floppy disk or electronic	Oracle and ASCII SFAF	allotment plans, equipment data, frequency assignment data, tactical assignments, JRFLs
ASPECTS	2 way	floppy disk or electronic	ASCII SFAF	frequency proposals and assignments
JSMS _w	2 way	floppy disk or electronic	ASCII SFAF	proposals, assignments, allotment plans
NPT	2 way	floppy disk	ASCII SFAF	allotment plans, frequency assignments

ACRONYM LIST

ACP	Allied Communication Publication
AFI	Air Force Instruction
AFC	Area Frequency Coordinator
AOR	Area of Responsibility
AR	Army Regulation
ASCII	American Standard Code for Information Interchange
ASPECTS	Automated Spectrum Planning, Engineering, Coordination and Tracking System
BEI	Background Environment Information
BPCS	Base, Post, Camp, and Station
CCB	Configuration Control Board
CCF	Consolidated Computing Facility
CD	Compact Disk
CEOI	Communications-Electronics Operating Instruction
CINC	Commander-in-Chief
CJCS	Commander, Joint Chiefs of Staff
CJCSI	Commander, Joint Chiefs of Staff Instruction
CL	Client
COA	Course of Action
COE	Common Operating Environment
CONOPS	Concept of Operations
COTS	Commercial Off-the-Shelf
CS	Central Server
C2	Command and Control
DBMS	Database Management System
DCF	Distributed Computing Facility
DII	Defense Information Infrastructure
DISA	Defense Information Systems Agency
DoD	Department of Defense
DOIM	Director of Information Management
EMC/V	Electromagnetic compatibility/vulnerability
EW	Electronic Warfare
E3	Electromagnetic Environmental Effects
FARS	Frequency Assignment Retrieval System
FCC	Federal Communications Commission
FRRS	Frequency Resource Record System
GCCS	Global Command and Control System
GMF	Government Master File
GUI	Graphical User Interface
HCL	Hardware Compatibility List
IOC	Initial Operating Capability
IRFMS	Inter-Service Radio Frequency Management School
ISYSCON	Integrated System Control
ITU	International Telecommunications Union
JCCC	Joint Communications Control Center

ACRONYM LIST (CONT.)

JCEWS	Joint Commander's Electronic Warfare Staff
JCSE	Joint Communications Support Element
JFMO	Joint Frequency Management Office
JIEO	Joint Interoperability and Engineering Organization
JRFL	Joint Restricted Frequency List
JSC	Joint Spectrum Center
JSM	Joint Spectrum Management
JSMS _w	Joint Spectrum Management System for Windows
JSOTF	Joint Special Operations Task Force
JTF	Joint Task Force
J2	Joint Staff, Intelligence Directorate
J3	Joint Staff, Operations Directorate
J5	Joint Staff, Plans and Policy Directorate
J6	Joint Staff, Communication and Computer Systems Directorate
LAN	Local Area Network
MS	Microsoft
MSE	Mobile Subscriber Equipment
MUES	Management and Use of the Electromagnetic Spectrum
NPT	Network Planning Terminal
NTIA	National Telecommunications and Information Administration
NTP	Naval Telecommunications Publication
OPLAN	Operations Plan
PDSS	Post Deployment Software Support
PATE	Product Acceptance Test and Evaluation
RBECS	Revised Battlefield Electronic CEOI System
RS	Regional Server
SC	Spectrum Certification
SCL	Software Compatibility List
SFAF	Standard Frequency Action Format
SIPRNET	Secret Internet Protocol Network
SQL	Structured Query Language
STU	Secure Telephone Unit
SYSCON	System Control
TACSYS	Tactical Systems
TPFDD	Time-Phased Force Deployment Data
WAN	Wide Area Network
WG	Working Group